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**UNITED STATES PATENT APPLICATION**

of

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and

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for

**HYDRAULICALLY AND VOLUMETRICALLY  
DISPENSING FLUID**

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## **BACKGROUND OF THE INVENTION**

### **1. Related Applications**

This application is a continuation of and claims priority to U.S. Patent Application  
5 Serial No. 10/016,970 filed December 14, 2001, entitled HYDRAULICALLY AND  
VOLUMETRICALLY DISPENSING A TARGET FLUID.

### **2. Field of the Invention**

The present invention relates to hydraulically and volumetrically dispensing fluid.  
10 More particularly, the present invention relates to systems and methods for dispensing a  
known volume of a target fluid, whether liquid and/or gas, through the use of a hydraulic  
system.

### **3. Background and Related Art**

15 Historically, a variety of techniques have been employed to dispense materials. Such  
techniques have included pushing a material through a flexible conduit, using a water control  
valve to provide pressure to a material, employing a water control valve to dispense the  
material, and using a hand-held applicator that accommodates a syringe, each of which will  
be discussed below.

20 A first technique employs a flexible conduit through which a material is pushed. In  
United States Patent No. 5,878,921, a grout delivery apparatus and method is disclosed for  
delivering grout through a flexible conduit from a bulk supply of grout to a hand tool. The  
bulk supply of grout is held in a hopper, which feeds the grout under gravity to a pump. The  
pump is driven by an electric motor, which receives its electrical energy through a controller.

The controller is adjustably preset to control the electric motor as a function of the individual settings on a malfunction switch operable by the worker. The switch can either be mounted on the hand tool and directly wired to the controller or incorporated into a remote transmitter, which transmits the particular switch position to a receiver on the controller. Similarly, 5 United States Patent No. 6,268,000 discloses a device for dispensing pastry dough, frosting, or icing from a cartridge. The device has a cartridge container and a hand-held gun. An electric motor having a piston is coupled to the cartridge container. The piston acts on a plunger of the cartridge to apply pressure on the pastry dough, frosting, or icing to permit the pastry dough, frosting, or icing to move to the gun to be dispensed. The technique in both 10 disclosures requires a material to be pushed through a tube or flexible conduit in order to dispense or apply the material. One disadvantage of this technique is that residue of the material is typically left behind on the inside wall of the tube or conduit that must be cleaned. This requirement of cleaning the tube or conduit can be time consuming and the residue indicates a waste of a portion of the material.

15 In a second technique, a water control valve is employed to provide direct pressure to a material that is being dispensed. This technique is disclosed in United States Patent No. 6,041,977, which discloses a dispensing system for dispensing decorating materials, such as frosting. The dispensing system includes a dispensing tube having the material to be dispensed and a water-operated piston. Application of water under pressure to the dispensing 20 tube results in the dispensing of the material through a decorating tip. The water pressure applied to the dispensing tube is controlled and regulated through the utilization of a control valve assembly having a flow stop valve and an on/off valve. Water applied to the control valve assembly is pressure regulated and filtered. While this technique reduces the

requirement for cleaning and reduces the amount of material wasted, it requires the constant pressurizing of water and typically proves to be awkward in use of some applications.

A third technique employs compressed air to dispense a material. This technique illustrated in United States Patent No. 5,964,381, in which a piston is disposed inside a tube  
5 having an inner cross-sectional size and shape uniform along its length. The tube has an open end. The piston is free to move literally inside the tube and preferably may move out of the tube through the open end. If the tube is cylindrical in shape it has a constant inner diameter. The open end of the tube is neither tapered nor flaring. Liquid samples are aspirated into the device by pulling the piston back. The sample is then ejected by  
10 accelerating the piston to a minimum velocity to force the liquid sample out of the open end of the tube. The velocity of the sample is sufficient to render negligible effects of surface tension forces. The volume of the liquid sample dispensed is determined by the inner diameter of the tube and the piston displacement. Accurate positioning of the piston provides samples of accurate volumes. This technique can provide an accurate delivery of a material  
15 as long as the viscosity of the air does not change. However, a change in atmospheric temperature and/or pressure affects the technique by requiring the system to be adjusted for each given atmospheric modification. As such, this technique can prove to be time consuming, as it requires the calibration to the various surrounding conditions.

Another technique is provided in United States Patent No. 5,630,527, which discloses  
20 a fluid dispenser system, and method of use thereof, primarily in industrial applications requiring the dispensing of fluids, such as epoxies, silicones, adhesives, etc., allowing for very precise control of the volume of fluid extruded. The system comprises an ergonomic, hand-held applicator accommodating a conventional medical syringe, wherein the applicator

is attached to an electronic control unit by a power cord. The applicator is provided with a stepping motor that drives a piston or screw a specific distance in response to an electronic signal generated by the control unit. Displacement of the piston or screw creates a positive pressure on a fluid contained in the syringe, thereby causing fluid extrusion from the syringe.

- 5 While this technique can dispense a precise amount of material, the apparatus of the hand-held applicator can prove to be bulky and awkward to use.

Thus, while techniques currently exist that are used to apply or dispense a material, challenges still exist, including causing a portion of the material to be wasted, needing to clean the residue from the material after each use, requiring a calibration of the device for  
10 each surrounding condition, and other such challenges. Accordingly, it would be an improvement in the art to augment or even replace current techniques with other techniques.

## **SUMMARY OF THE INVENTION**

The present invention relates to hydraulically and volumetrically dispensing fluid. More particularly, the present invention relates to systems and methods for dispensing a known volume of target fluid through the use of a hydraulic system. As used herein, “known  
5 volume” means a metered controlled predeterminable quantity of fluid or in some embodiments a predetermined quantity of fluid which has a controlled volume or quantity such as a bolus.

Implementation of the present invention takes place in association with a target fluid, whether in a liquid and/or gaseous state, that is to be dispensed. A hydraulic system is  
10 configured to selectively provide mechanical pressure in order to dispense a volumetric or metered dose of the target fluid from a container, syringe, etc., which includes a slidable or movable plunger or wall that when moved forces the target fluid out of the container or syringe or draws substances into the container or syringe.

In one implementation, a dispensing system includes an actuator, such as a motor or  
15 driver, a hydraulic coupler, column or tube that includes substantially incompressible hydraulic liquid, and a mechanical interface to the container or syringe. The actuator may comprise a motor or driver, such as a step motor, linear actuator, servomotor, pneumatic motor, or other similar device, to drive a plunger or piston of the hydraulic coupler. The coupler includes a conduit, column, shaft or other leakproof assembly that acts as a conduit  
20 for the substantially incompressible hydraulic liquid. The conduit is connected at one end to a plunger/piston and at the other end to a mechanical interface. The mechanical interface includes a cylinder structure with another plunger or piston that is selectively pushed by the incompressible hydraulic liquid, thereby driving a head of the plunger or piston to press

against the wall or plunger of the container or syringe that contains the target fluid, causing the target fluid to be dispensed therefrom. Thus, an actuator selectively provides a force on the hydraulic coupler, which transfers the force to the target fluid to dispense the target fluid from the container. In one implementation, a controller or computer device is coupled to the  
5 actuator to accurately dispense a volumetric amount of the target fluid.

While the methods and processes of the present invention have proven to be particularly useful in the area of dispensing a precise amount of target fluid, those skilled in the art can appreciate that the methods and processes can be used in a variety of different applications and in a variety of different areas of manufacture and/or industry to accurately  
10 dispensing a volumetric amount of fluid.

These and other features and advantages of the present invention will be set forth or will become more fully apparent in the description that follows and in the appended claims. The features and advantages may be realized and obtained by means of the instruments and combinations particularly pointed out in the appended claims. Furthermore, the features and  
15 advantages of the invention may be learned by the practice of the invention or will be obvious from the description, as set forth hereinafter.

## **BRIEF DESCRIPTION OF THE DRAWINGS**

In order that the manner in which the above recited and other features and advantages of the present invention are obtained, a more particular description of the invention will be rendered by reference to specific embodiments thereof, which are illustrated in the appended  
5 drawings. Understanding that the drawings depict only typical embodiments of the present invention and are not, therefore, to be considered as limiting the scope of the invention, the present invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

Figure 1 illustrates a representative system that provides a suitable operating  
10 environment to dispense a volumetric amount of target fluid in accordance with the present invention;

Figure 2 illustrates a cross-sectional view of various components of the representative system of Figure 1;

Figure 3 illustrates an alternative actuator that may be used in association with the  
15 present invention;

Figure 4 illustrates another alternative an actuator that may be used in association with the present invention;

Figure 5 illustrates a representative system that may be used in accordance with the present invention to mix and/or dispense a multipart target fluid therefrom, or to dispense a  
20 plurality of volumetric amounts of one or more target fluids; and

Figure 6 provides a representative controller system that may be used in association with the present invention to dispense an accurate a precise volumetric amount of target fluid.

## **DETAILED DESCRIPTION OF THE INVENTION**

The present invention relates to hydraulically and volumetrically dispensing target fluid. More particularly, the present invention relates to systems and methods for dispensing a known volume of target fluid through the use of a hydraulic system.

5           In the disclosure and in the claims the term “target fluid” shall refer to any material that may be dispensed, whether in a liquid and/or gaseous state. Examples of target fluid include medication, water, oil, grease, paint, adhesive, solvent, lotion, food products (e.g., baby food, condiments, juice, etc.), lubrication, epoxy, silicone, sealant, oxygen, hydrogen, nitrogen, air, and any other liquid and/or gas that have a rheology compatible with being  
10       dispensed by physical force. Furthermore, the term “target fluid” shall include materials that are not in a liquid and/or gaseous state, but which may still be dispensed, such as a powder (e.g., graphite), or a paste (e.g., solder paste).

The following disclosure of the present invention is grouped into two subheadings, namely “Hydraulically Dispensing Target fluid” and “Utilizing a Computer Device.” The  
15       utilization of the subheadings is for convenience of the reader only and is not to be construed as limiting in any sense.

### **Hydraulically Dispensing Target fluid**

Embodiments of the present invention take place in association with a target fluid that  
20       is to be dispensed. Figure 1 and the corresponding discussion are intended to provide a general description of a representative embodiment or suitable operating environment in which the invention may be implemented. One skilled in the art will appreciate that the invention may be practiced by one or more systems, and in a variety of system

configurations, to enable target fluid to be hydraulically and volumetrically dispensed in accordance with the present invention.

In Figure 1, a representative system is illustrated as dispensing system 10 that may be used to selectively dispense target fluid. System 10 includes an actuator 12, a hydraulic  
5 coupler 14, and a container of target fluid 16 to be dispensed. Actuator 12 is a driving mechanism, which is an example of actuator means. Particular examples of a driving mechanism include a step motor, a linear actuator, a servomotor, pneumatic motor, a variable frequency drive, or other similar motor or device that may be configured to initiate or create a force at a controlled or selected rate or step.

10 Actuator 12 creates a linear force on screw 13 that is transferred to hydraulic coupler 14. Coupler 14 is an example of hydraulic means. By way of example, hydraulic coupler 14 comprises a master cylinder 18, a conduit 19, a slave cylinder 20, and optionally a connector 17 for selectively coupling to container 16. Those skilled in the art will appreciate that while cylinders are illustrated in the present embodiment, a variety of different shapes and/or sizes  
15 may be used as part of a hydraulic coupler to provide a master-slave relationship.

While Figure 1 illustrates the use of a block or component that connects screw 13 to a shaft of master cylinder 18, embodiments of the present invention embrace a direct coupling of a cylinder shaft to an actuator. For example, the cylinder shaft is a proximal portion of a piston that may be displaced within a cylinder, wherein the proximal end of the shaft is  
20 threaded to directly couple to an actuator.

With reference to Figure 2, hydraulic coupler 14 is configured to contain a substantially incompressible hydraulic liquid 38, such as silicone, water, silicone oil, alcohol, brake fluid, food grade hydraulic liquid, or another hydraulic liquid that has properties

preventing expansion or contraction over a broad enough temperature range. Hydraulic liquid 38 extends from a first hydraulic piston head 30, at least a portion of which is contained within master cylinder 18, through conduit 19, and to a second hydraulic piston head 34, at least a portion of which is contained within slave cylinder 20. This allows a force  
5 by piston head 30 to transfer to piston head 34, causing the master-slave relationship. Similarly, a force from piston head 34 may be transferred to piston head 30. In order to prevent leakage of hydraulic liquid 38, one or more seals may be placed at or near the respective heads of piston heads 30 and 34. In Figure 2, the seals are respectively illustrated as O-rings 32 and 36. While an O-ring is illustrated in the present embodiment, those skilled  
10 in the art will appreciate that other seals may be used, such as one or more quad seals, or one or more flaps.

In the illustrated embodiment, actuator 12 initiates a force that displaces piston 30. The displacement of a piston, such as piston 30, is an example of actuating the hydraulic means. A force that displaces a piston may be hydraulically transferred to one or more other  
15 pistons to selectively dispense a target fluid or fill a container with target fluid.

While the embodiment illustrated in Figure 2 illustrates a hydraulic coupler/system that comprises two pistons/plungers, embodiments of the present invention embrace hydraulic couplers/systems that comprise more than two pistons/plungers. One such embodiment includes a Y-shaped hydraulic coupler that comprises three pistons/plungers,  
20 wherein one is used as a master and the other two are used as slaves.

With reference back to Figure 1, one or more vents, illustrated as apertures 26 and 28, permit the user to selectively allow for gas, such as atmospheric air, to enter and exit

cylinders 18 and 20, thereby allowing piston heads 30 and 34 (Figure 2) to be displaced as desired. Apertures 26 and 28 may also be used to purge undesirable gases.

In Figure 1, container 16 is configured to contain a target fluid therein and is coupled to hydraulic coupler 14 at connector 17. Container 16 is an example of dispensing means.

5 Furthermore, the term “dispensing means” includes a plurality of dispensing means per hydraulic means. With reference to Figure 2, a cross-sectional view of system slave cylinder 20, connector 17 and container 16 is provided. In the illustrated embodiment, container 16 is configured to contain a reservoir of target fluid 46 that may be selectively and accurately dispensed from container 16 in accordance with the present invention. In one embodiment,  
10 container 16 includes a slidable or movable wall or cap (illustrated as cap 44) to contain and dispense target fluid 46. Other embodiments embrace the use of a slidable or movable plunger to contain and dispense the target fluid.

Container 16 may be removably or fixably coupled to hydraulic coupler 14. In the illustrated embodiment, container 16 includes a surface 48 that may be selectively and  
15 rotatably coupled to receiver 50 of connector 17. When coupled, a distal end 40 of piston head 34 extends down at least a portion of container 16. In the illustrated embodiment, a seal 42 is coupled to distal end 40 to prevent target fluid 46 from escaping. Thus, as a force is transferred to piston head 34, distal end 40 moves toward distal end 57 of container 16 to cause an amount of the target fluid 46 to be dispensed therefrom. In a further embodiment,  
20 container 16 comprises a polymer and/or is disposable.

In one embodiment, an additional optional feature is disclosed. As illustrated in Figure 2, container 16 may be coupled to a target fluid source 52 through the use of a target fluid source connector 54. Thus, the withdrawal of piston head 30 or otherwise movement of

piston head 34 toward piston head 30 enables target fluid from target fluid source 52 to enter container 16. Furthermore, a valve 56 may be used to selectively fill container 16 with target fluid 46 from target fluid source 52 or dispense target fluid 46 from container 16 through distal end 57.

5           As provided above, embodiments of the present invention embrace the use of a hydraulic system that is configured to selectively provide controlled mechanical pressure in order to dispense a volumetric or metered dose of the target fluid from a container, syringe, or other target fluid source. The driving mechanism actuates a force on the hydraulic coupler/system, which transfers the force to the target fluid in order to selectively dispense an  
10   amount of target fluid. Moreover, as will be further discussed herein, a driving mechanism may actuate a force on the hydraulic coupler/system to fill at least a portion of a container with target fluid.

          As illustrated in the embodiment of Figure 1, another feature is disclosed. A controller 22 may be coupled to actuator 12 to cause actuator 12 to create a precise force on  
15   hydraulic coupler 14. As will be discussed below, one example of a controller is a computer device that may be selectively programmed to control actuator 12. Embodiments of the present invention embrace the use of feedback, such as feedback sent from actuator 12 to controller 22. An input device 24 may be coupled to controller 22 to enable user input. The control of the force created by the driving mechanism (actuator 12) and transferred to  
20   hydraulic coupler enables for a precise volumetric or metered dose or amount of target fluid to be dispensed.

          Those skilled in the art will appreciate that a variety of different types and sizes of driving mechanisms and configurations thereof may be used in accordance with the present

invention to selectively dispense target fluid. For example, with reference to Figures 3 and 4 two alternative embodiments of driving mechanisms are provided. In Figure 3, a representative driving mechanism 60 is illustrated that includes motor 62, which is an example of an actuator, and driving components 64 that provide a force onto a hydraulic coupler/system. Similarly, in Figure 4 a representative driving mechanism 70 is illustrated that includes motor 72, gear box 74 and driving components 76. Thus, driving mechanisms used in accordance with the present invention may be a direct-drive mechanism, may include one or more belts and/or gears, and/or may utilize some type of transmission or gear change. Furthermore, the drive mechanisms may be in-line or indirect. Moreover, any driving mechanism is contemplated so long as it permits the user to selectively choose the amount of force created, i.e., displacement of driving component which acts upon hydraulic coupler 14.

Those skilled in the art will appreciate that embodiments of the present invention embrace a variety of different system configurations. For example, in one embodiment a dispensing system is configured in accordance with the present invention to manually dispense target fluid. In another embodiment, a dispensing system is configured to automatically dispense a volumetric amount of target fluid. For example, a distal portion of system 10 (Figure 1) including connector 17 and container 16 may be coupled to an X-Y or an X-Y-Z mechanical system or mechanism that receives input from a controller, such as controller 22 or another controller or computer device, to precisely locate container 16 and dispense a precise volumetric amount of the target fluid within container 16 at the desired location. In a further embodiment, a system may include a plurality of containers to selectively and accurately dispense, for example, a multiple-part target fluid or multiple volumetric amounts of the target fluid simultaneously or in a series of dispensing events.

For example, and with reference to Figure 5, an alternative embodiment of the present invention is illustrated as system 80, which includes multiple actuators 82, hydraulic couplers 86, and containers 88. The combination of hydraulic couplers 86 is an example of hydraulic means. Furthermore, while two actuators, hydraulic couplers, and containers are illustrated, 5 embodiments of the present invention embrace more than two or any combination of any number of actuators, hydraulic couplers, and containers. Furthermore, the number of actuators, hydraulic couplers and containers are not required to dispense directly proportional amounts of target fluid(s). Still further, another example one embodiment of the present invention includes a single actuator and multiple hydraulic couplers and containers.

10 In Figure 5, a first target fluid is contained within container 88a and a second target fluid is contained within container 88b. This embodiment is useful for such applications as dispensing a two-part target fluid, such as a two-part epoxy. In the illustrated embodiment, a chamber 90, which may include a vortex (not shown), is coupled to containers 88. As target fluids are dispensed from containers 88, the target fluids are mixed in chamber 90 and 15 dispensed therefrom. The use of multiple actuators enables the ration of each target fluid of the resultant combination of target fluids to be controlled. Therefore, in accordance with the present invention a multi-part target fluid is volumetrically dispensed that may include a direct ratio (e.g., 1:1) of target fluids or an indirect ration (e.g., 1:2, 1:10, 1:100) of target fluids. In another embodiment, chamber 90 may direct different target fluid to be dispensed 20 without mixing but in a spaced or relative position to each other. While Figure 5 illustrates the ability to dispense two target fluids, any plurality of target fluids may be so dispensed.

### **Utilizing a Computer Device**

As provided above, one or more controllers may be used to control one or more actuators. One example of a controller is a computer device. As such, the following provides a discussion relating to a computer device that may be selectively used in accordance with the present invention.

Embodiments of the present invention embrace the use of one or more computer readable media to hydraulically and volumetrically fill a container with target fluid and/or dispense target from a container, wherein each medium may be configured to include or includes thereon data or computer executable instructions for manipulating data. The computer executable instructions include data structures, objects, programs, routines, or other program modules that may be accessed by a processing system, such as one associated with a general-purpose computer capable of performing various different functions or one associated with a special-purpose computer capable of performing a limited number of functions. Computer executable instructions cause the processing system to perform a particular function or group of functions and are examples of program code means for implementing steps for methods disclosed herein. Furthermore, a particular sequence of the executable instructions provides an example of corresponding acts that may be used to implement such steps. Examples of computer readable media include random-access memory ("RAM"), read-only memory ("ROM"), programmable read-only memory ("PROM"), erasable programmable read-only memory ("EPROM"), electrically erasable programmable read-only memory ("EEPROM"), compact disk read-only memory ("CD-ROM"), or any other device or component that is capable of providing data or executable instructions that may be accessed by a processing system.

With reference to Figure 6, a representative system for use in accordance with the present invention includes computer device 100, which may be a general-purpose or special-purpose computer. For example, computer device 100 may be a personal computer, a notebook computer, a personal digital assistant ("PDA") or other hand-held device, a  
5 workstation, a minicomputer, a mainframe, a supercomputer, a multi-processor system, a network computer, a programmable logic controller, a processor-based consumer electronic device, or the like.

Computer device 100 includes system bus 102, which may be configured to connect various components thereof and enables data to be exchanged between two or more  
10 components. System bus 102 may include one of a variety of bus structures including a memory bus or memory controller, a peripheral bus, or a local bus that uses any of a variety of bus architectures. Typical components connected by system bus 102 include processing system 104 and memory 106. Other components may include one or more mass storage device interfaces 108, input interfaces 110, output interfaces 112, and/or network interfaces  
15 114, each of which will be discussed below.

Processing system 104 includes one or more processors, such as a central processor and optionally one or more other processors designed to perform a particular function or task. It is typically processing system 104 that executes the instructions provided on computer readable media, such as on memory 106, a magnetic hard disk, a removable magnetic disk, a  
20 magnetic cassette, an optical disk, or from a communication connection, which may also be viewed as a computer readable medium.

Memory 106 includes one or more computer readable media that may be configured to include or includes thereon data or instructions for manipulating data, and may be

accessed by processing system 104 through system bus 102. Memory 106 may include, for example, ROM 118, used to permanently store information, and/or RAM 120, used to temporarily store information. ROM 118 may include a basic input/output system ("BIOS") having one or more routines that are used to establish communication, such as during start-up  
5 of computer device 100. RAM 120 may include one or more program modules, such as one or more operating systems, application programs, and/or program data.

One or more mass storage device interfaces 108 may be used to connect one or more mass storage devices 116 to system bus 102. The mass storage devices 116 may be incorporated into or may be peripheral to computer device 100 and allow computer device  
10 100 to retain large amounts of data. Optionally, one or more of the mass storage devices 116 may be removable from computer device 100. Examples of mass storage devices include hard disk drives, magnetic disk drives, tape drives and optical disk drives. A mass storage device 116 may read from and/or write to a magnetic hard disk, a removable magnetic disk, a magnetic cassette, an optical disk, or another computer readable medium. Mass storage  
15 devices 116 and their corresponding computer readable media provide nonvolatile storage of data and/or executable instructions that may include one or more program modules such as an operating system, one or more application programs, other program modules, or program data. Such executable instructions are examples of program code means for implementing steps for methods disclosed herein.

20 One or more input interfaces 110 may be employed to enable a user to enter data and/or instructions to computer device 100 through one or more corresponding input devices 122. The input allows, for example, control of the amount and/or type of target fluid that is being filled and/or dispensed in accordance with the present invention. Examples of such

input devices include a keyboard and alternate input devices, such as a mouse, trackball, light pen, stylus, or other pointing device, a microphone, a joystick, a game pad, a satellite dish, a scanner, and the like. Similarly, examples of input interfaces 110 that may be used to connect the input devices 122 to the system bus 102 include a serial port, a parallel port, a game port, a universal serial bus (“USB”), a firewire (IEEE 1394), or another interface.

One or more output interfaces 112 may be employed to connect one or more corresponding output devices 124 to system bus 102. Examples of output devices include a monitor or display screen, a speaker, a printer, and the like. A particular output device 124 may be integrated with or peripheral to computer device 100. Examples of output interfaces include a video adapter, an audio adapter, a parallel port, and the like.

One or more network interfaces 114 enable computer device 100 to exchange information with one or more other local or remote computer devices, illustrated as computer devices 126, via a network 128 that may include hardwired and/or wireless links. The data exchange enables, for example, feedback of information to another system. Examples of network interfaces include a network adapter for connection to a local area network (“LAN”) or a modem, wireless link, or other adapter for connection to a wide area network (“WAN”), such as the Internet. The network interface 114 may be incorporated with or peripheral to computer device 100. In a networked system, accessible program modules or portions thereof may be stored in a remote memory storage device. Furthermore, in a networked system computer device 100 may participate in a distributed computing environment, where functions or tasks are performed by a plurality of networked computer devices. Those skilled in the art will appreciate that the invention may be practiced in networked computing environments with many types of computer system configurations that are used in association

with a hydraulic, volumetric target fluid dispenser for accurately dispensing target fluid in accordance with the present invention.

Thus, as discussed herein, the embodiments of the present invention embrace a variety of systems and methods for hydraulically and volumetrically dispensing fluid. More particularly, the present invention relates to systems and methods for dispensing a known  
5 volume of target fluid, whether in a liquid and/or gaseous state, through the use of a hydraulic system. The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention  
10 is, therefore, indicated by the appended claims rather than by the foregoing description. All changes that come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is: